

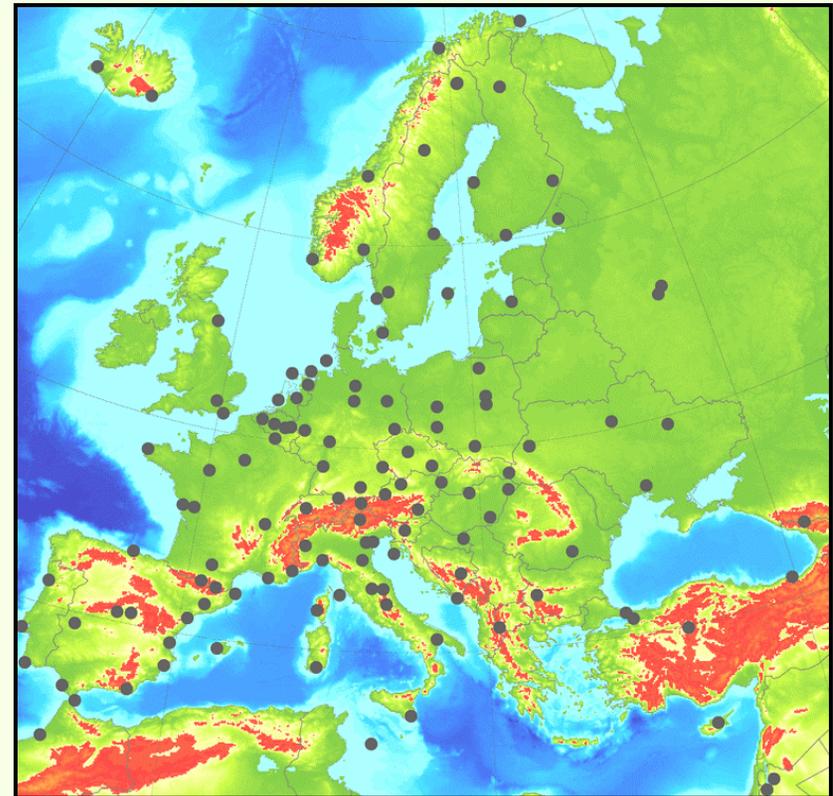
Detection and Handling of EPN Station Irregularities

**C. Bruyninx, G. Carpentier and
F. Roosbeek**

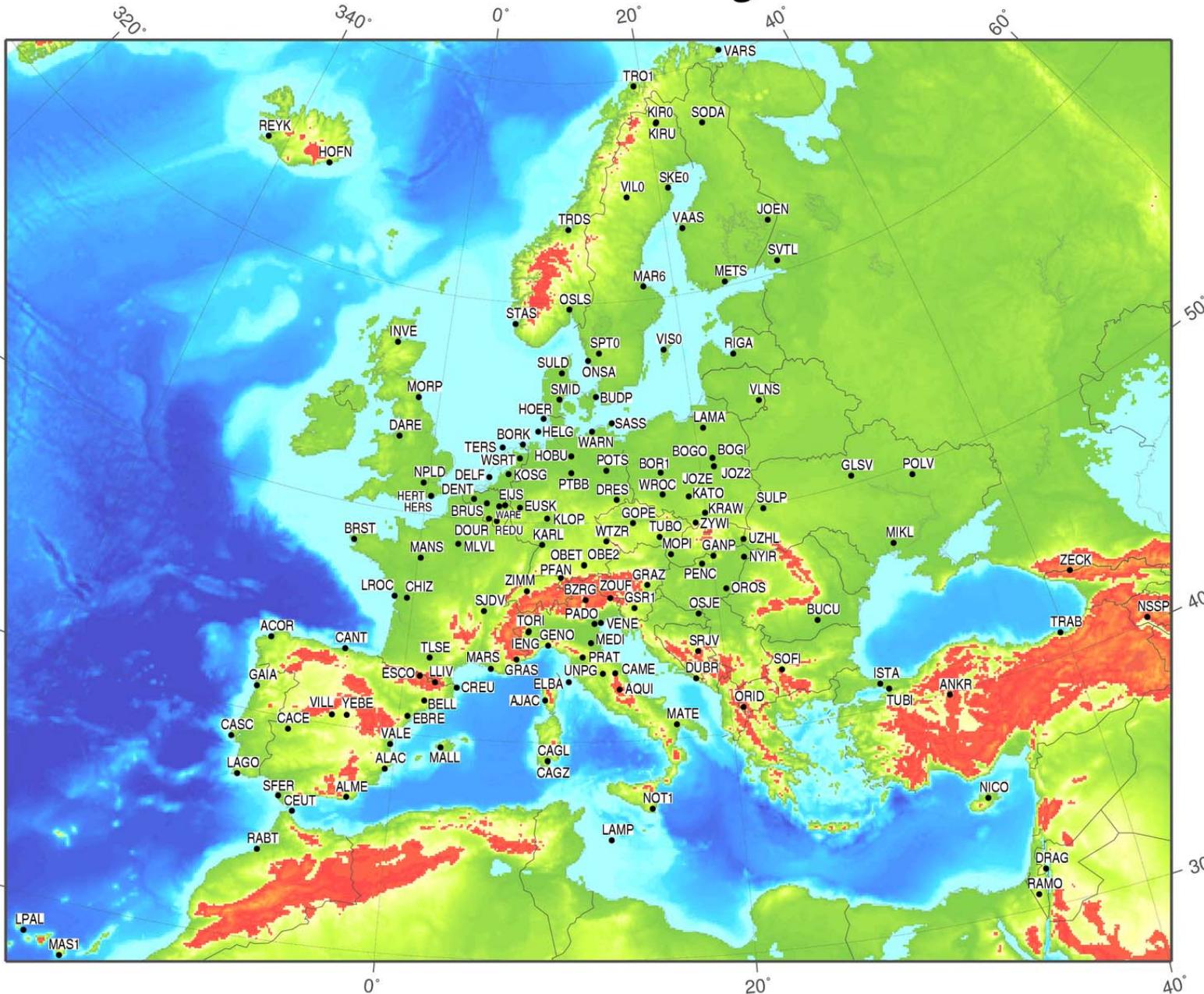
*EPN Central Bureau
Royal Observatory of Belgium*

A. Kenyeres

FOMI, Satellite Geodetic Observatory, Hungary



EUREF Permanent Tracking Network



Set up in 1995

152 stations
15 GPS/GLONASS

48% IGS stations

7 Data Centers
16 Analysis Centers

Operating under
IGS standards

THE PROBLEM

- **European national reference systems are based today on the reference frame provided by the EPN**
- **Densification campaigns, constraining ITRF2000 coordinates of EPN stations**
- **Necessary to know if the ITRF2000 coordinate can still be used today (changes after 2000)**
 - e.g. antenna change (discontinuity) after 2000

MONITORING STATION COORDINATES

Straightforward method:

Step 1 - Monitoring of tracking changes (RINEX data)

Step 2 - Creation of coordinate time series

Step 3 - Correlation with equipment changes

Step 4 - Correlation with changes in the tracking (from step 1)

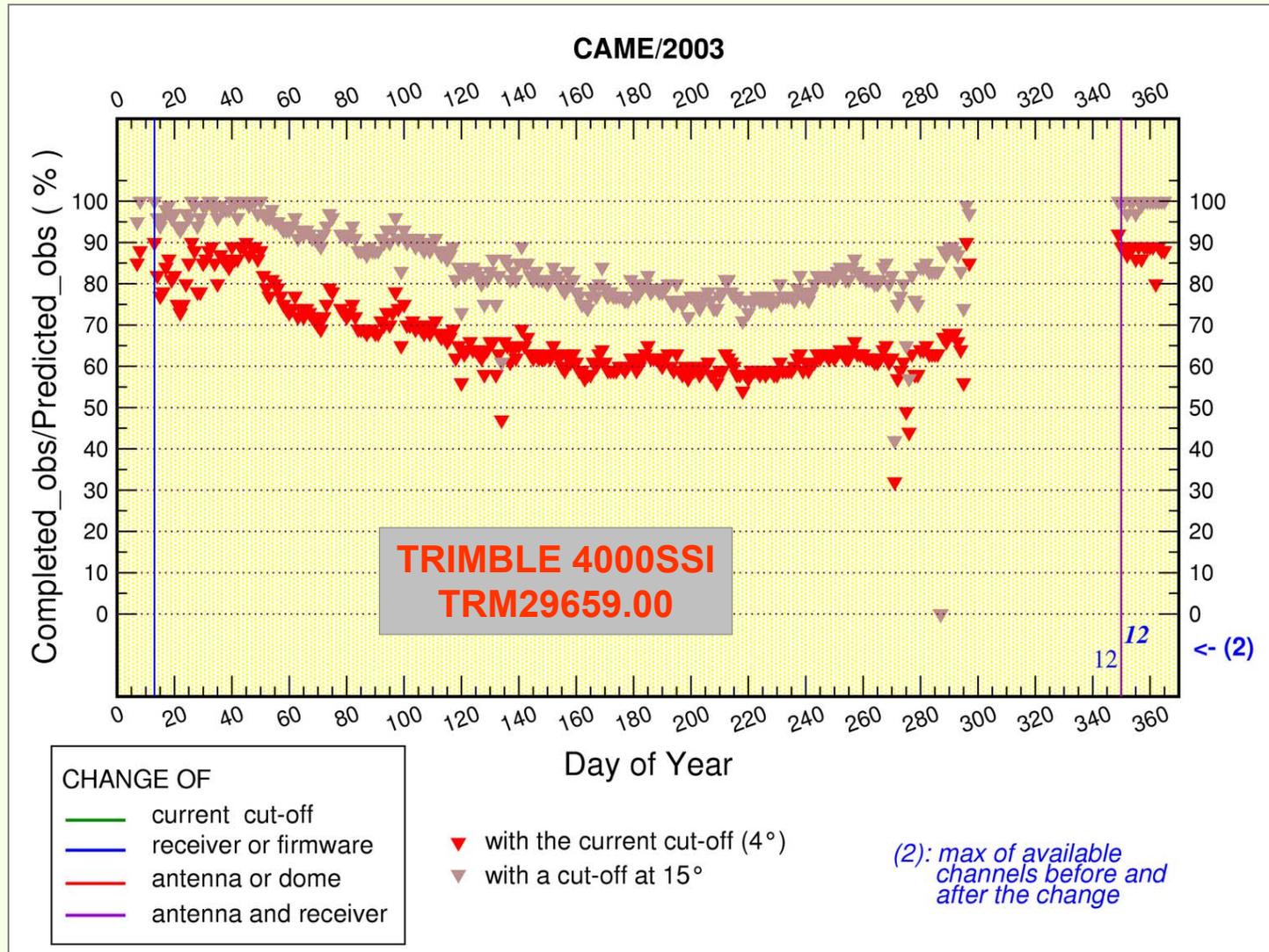
EPN Special Project ‘Time Series Monitoring’ uses information from Step 1 → Step 4 to :

- **Identify periods that station coordinates are unreliable**
- **Estimate coordinate discontinuities**



Monitoring RINEX data

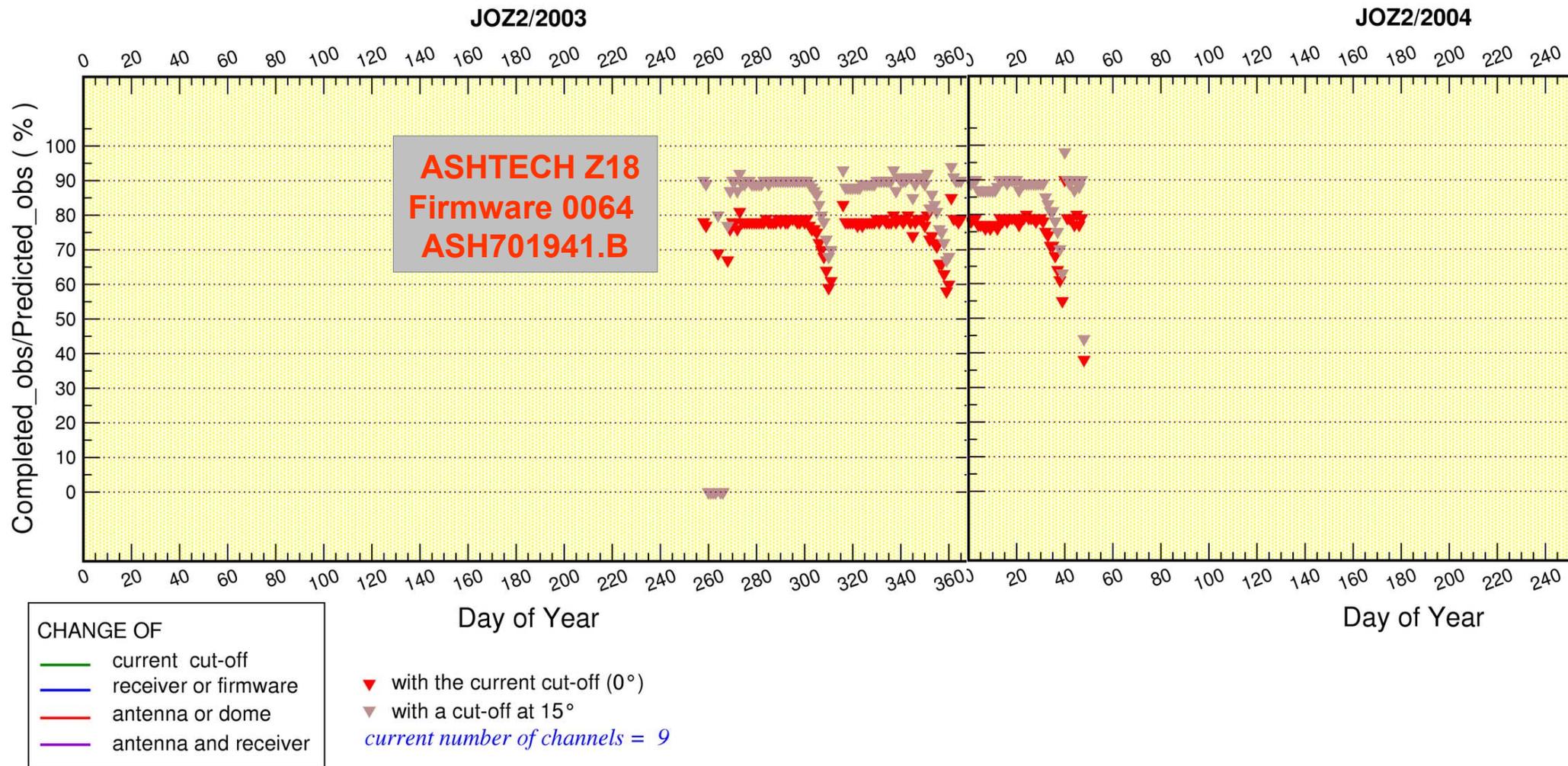
TOOL 1: Yearly overview of nr of observations



Updated daily
for each station

EPN CB web site
from 01/2001 on

EXAMPLE – JOZ2

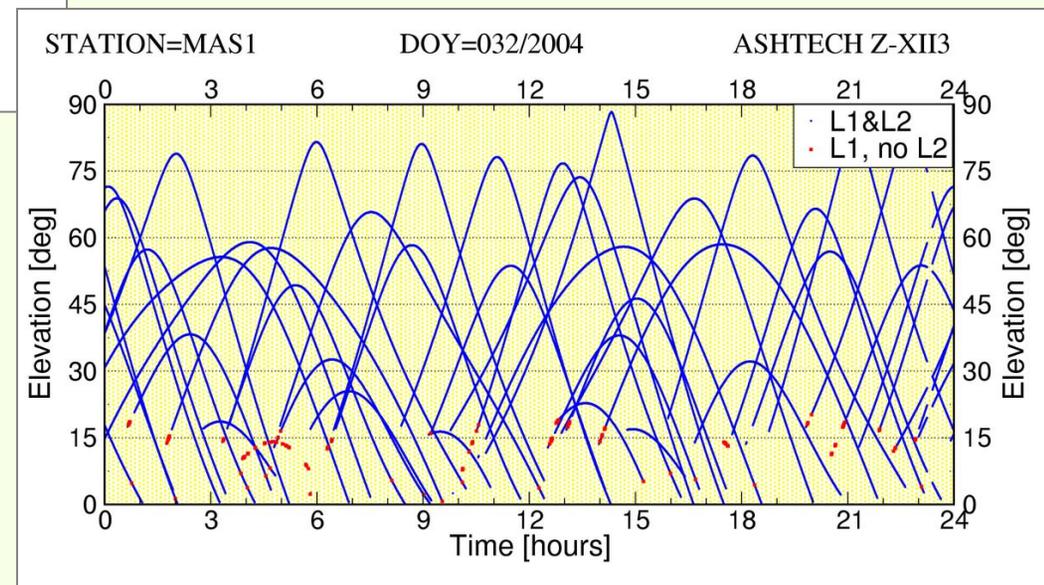
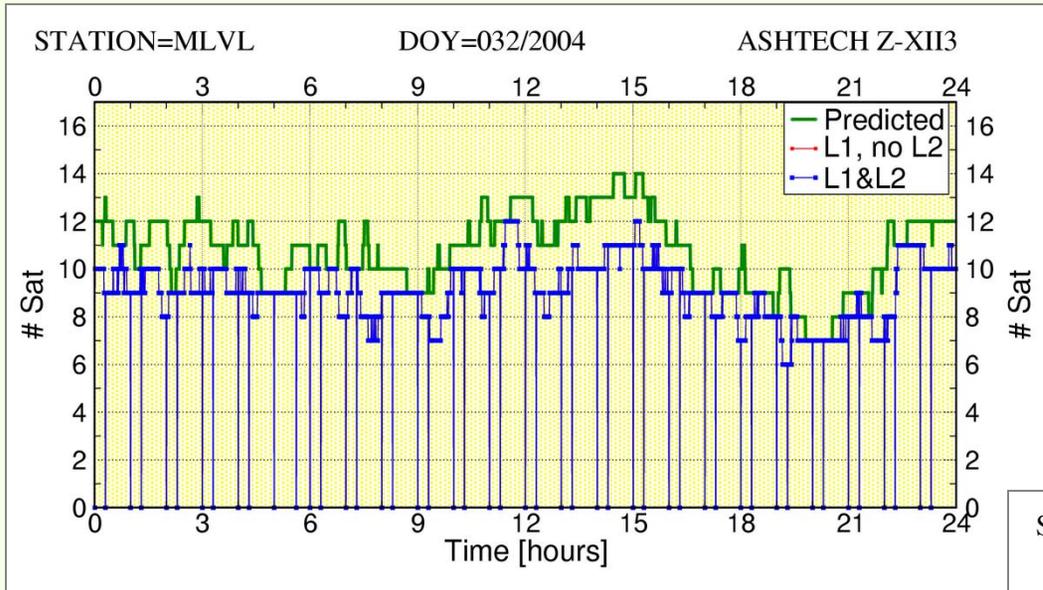




Monitoring RINEX data

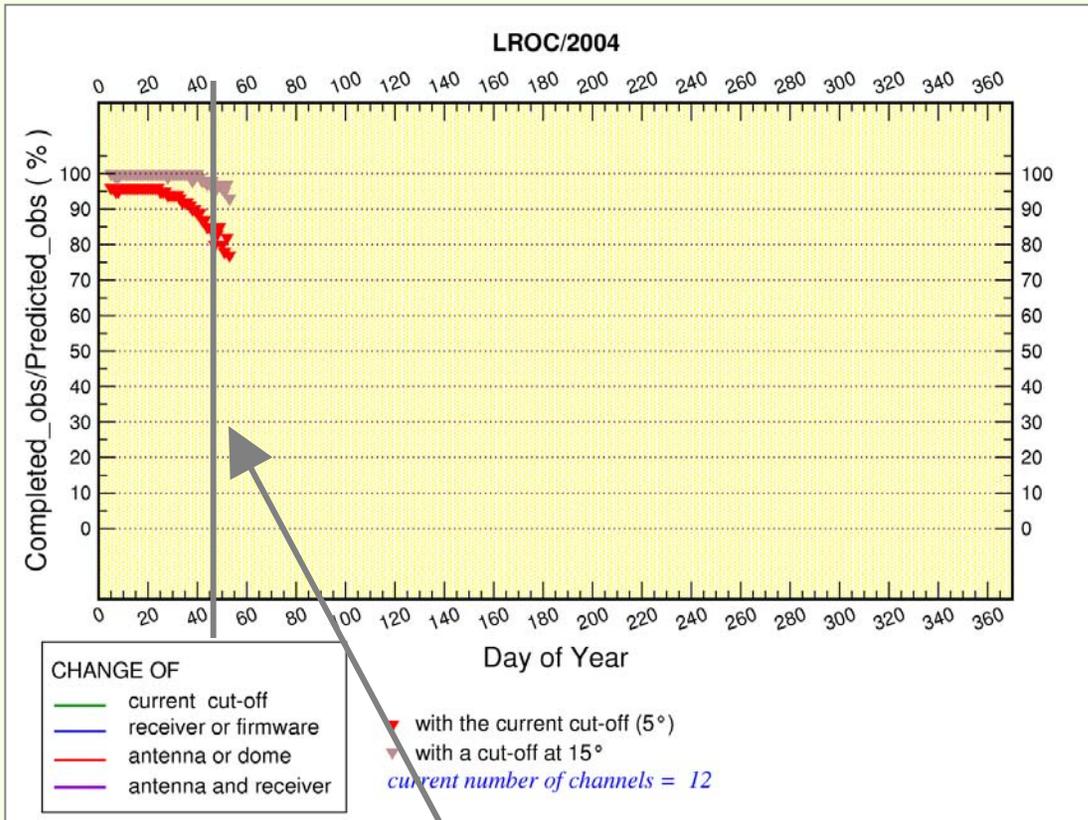


TOOL 2 : Monthly snapshots of tracking (1)

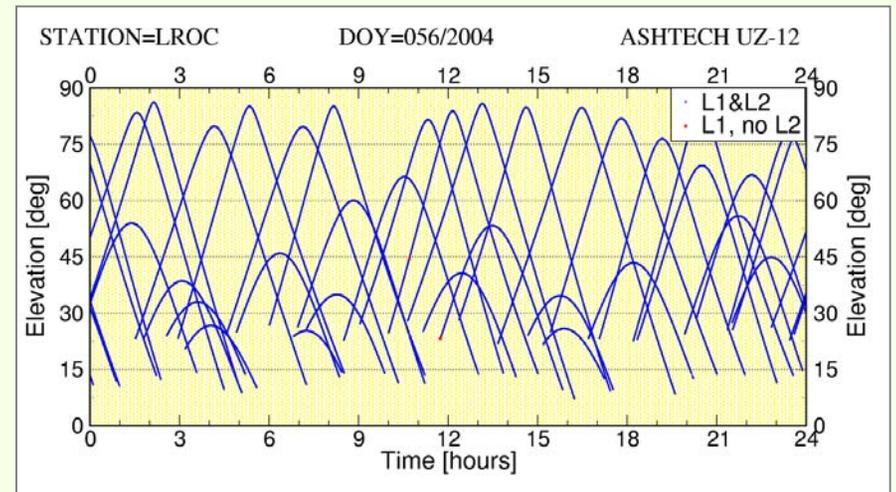
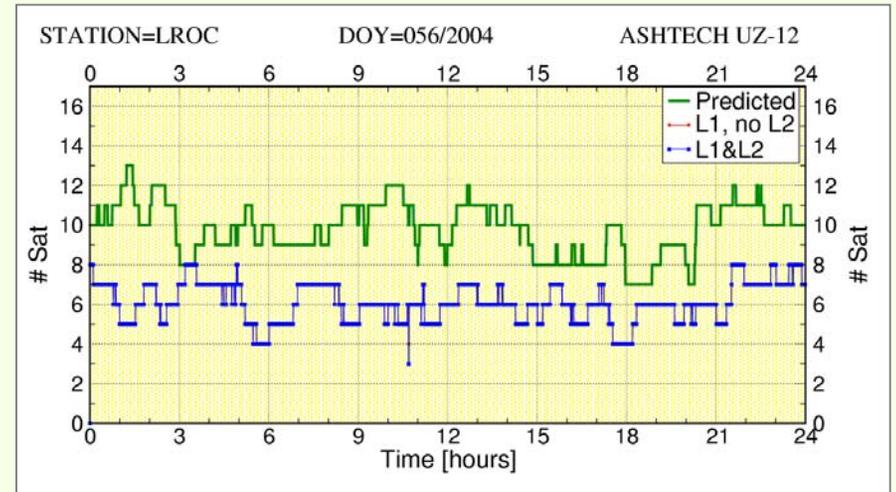


Available from March 2003 on

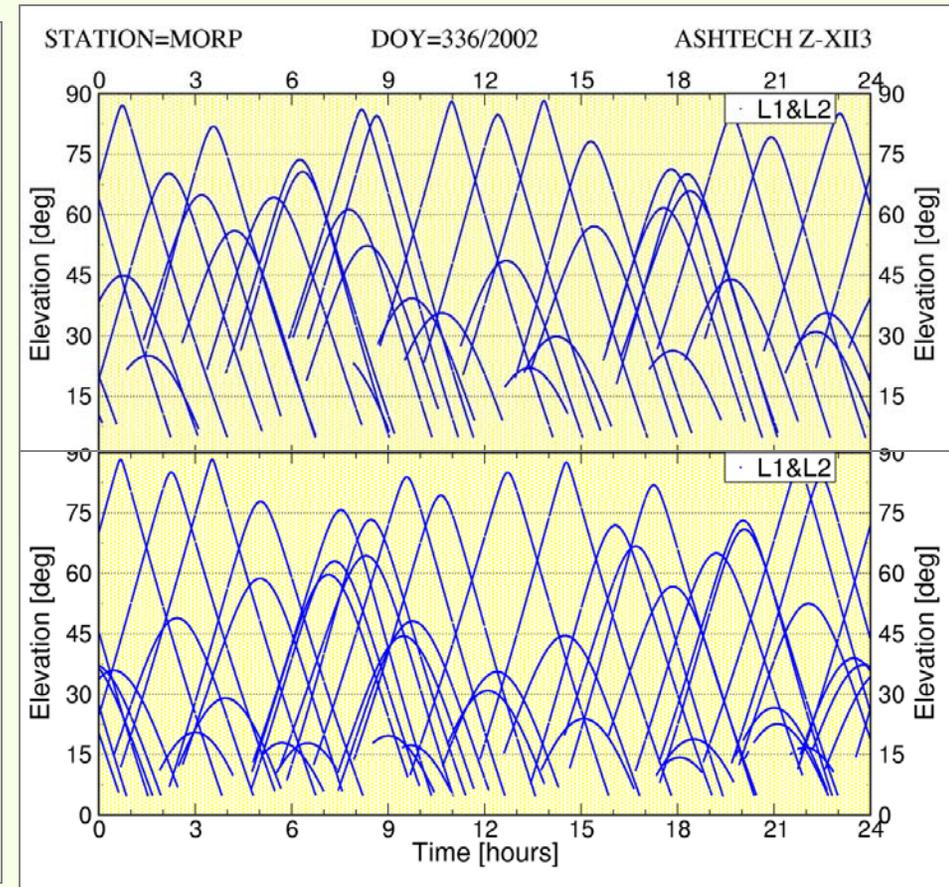
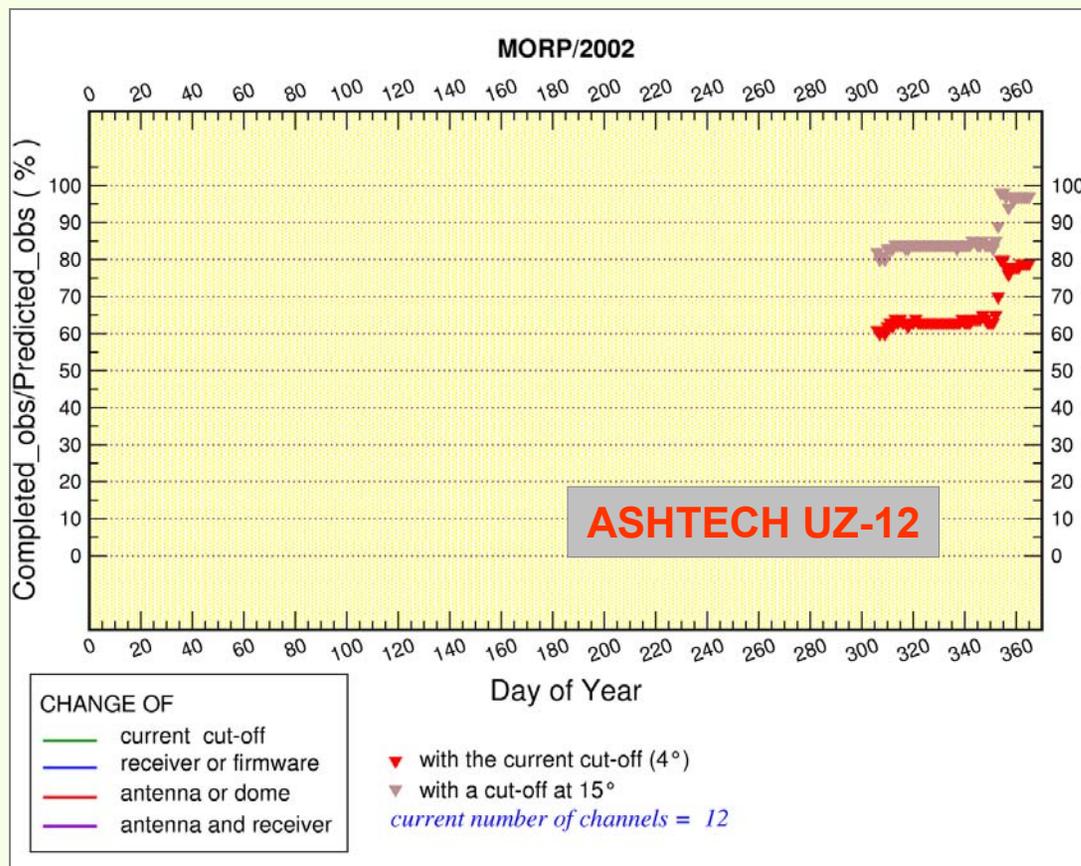
EXAMPLE - LROC



**Receiver reset
DOY 049/2004**



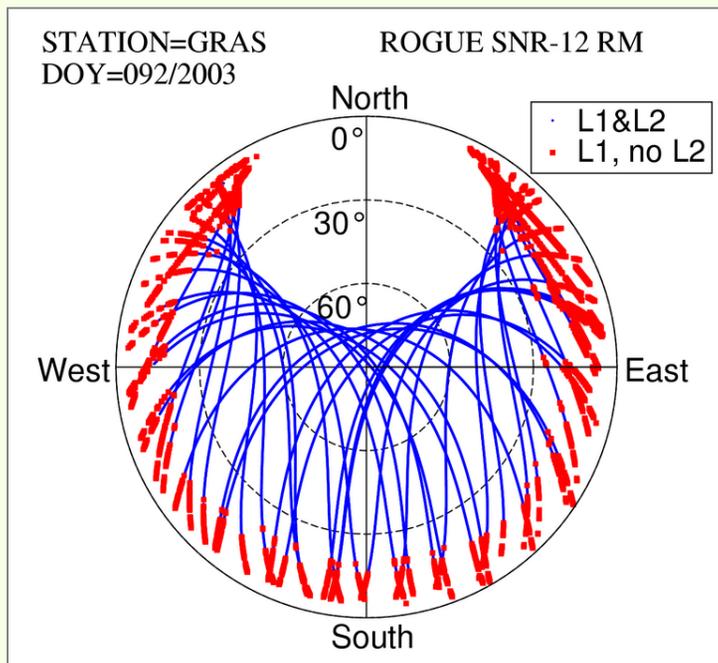
EXAMPLE -MORP



50 m cable → necessary to install Low Noise Amplifier (previously no tracking problems with Rogue)

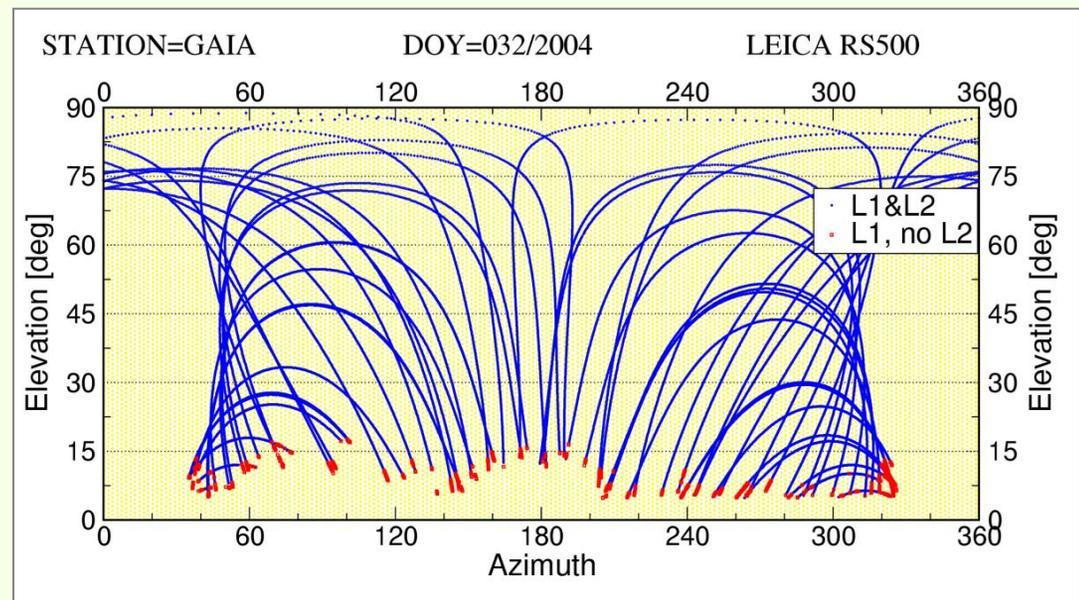
Monitoring RINEX data

TOOL 2 : Monthly snapshots of tracking (2)



Receiver was later replaced
with Trimble 4000SSI

Available at EPN CB
from March 2003 on



Monitoring RINEX data

TOOL 3 : TEQC-based quality check

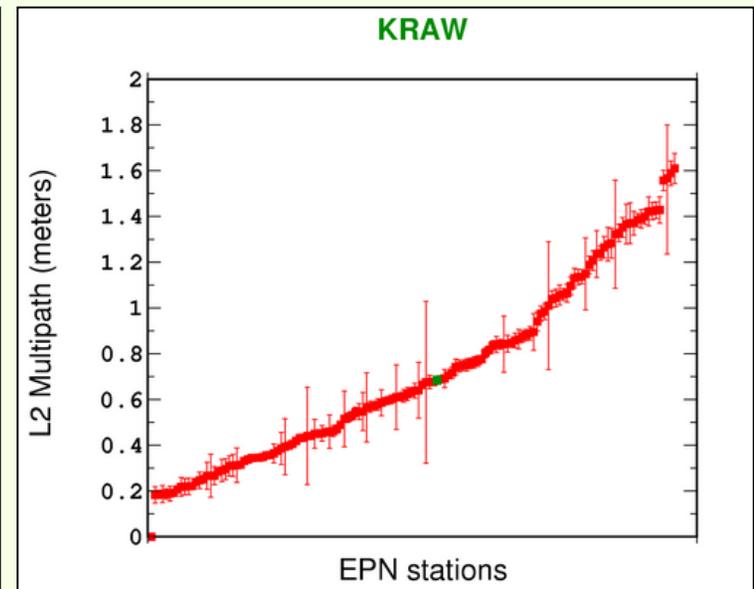
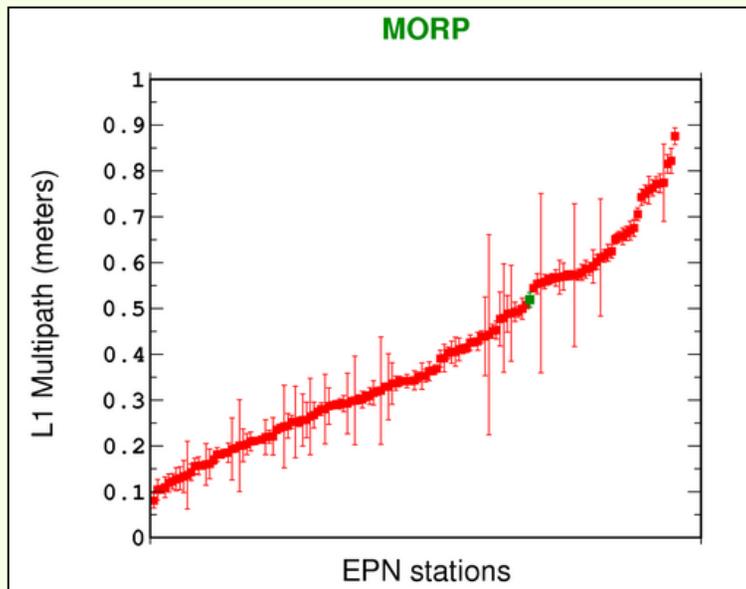
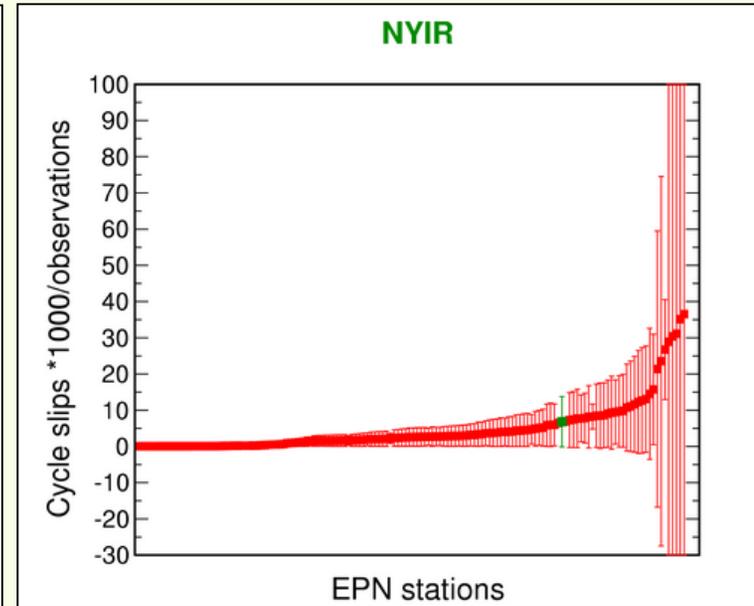
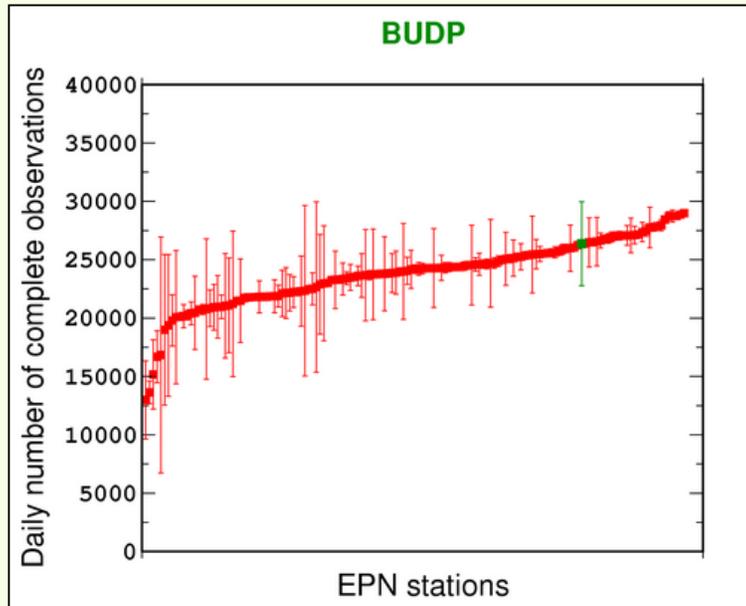
Using daily run of TEQC on all EPN data

- Number of complete observations (L1 & L2)
- RMS MP1 (L1 multipath) and MP2 (L2 multipath)
- Observations per cycle slip (inverted and multiplied by 1000)

2 graphs (back to January 2003) :

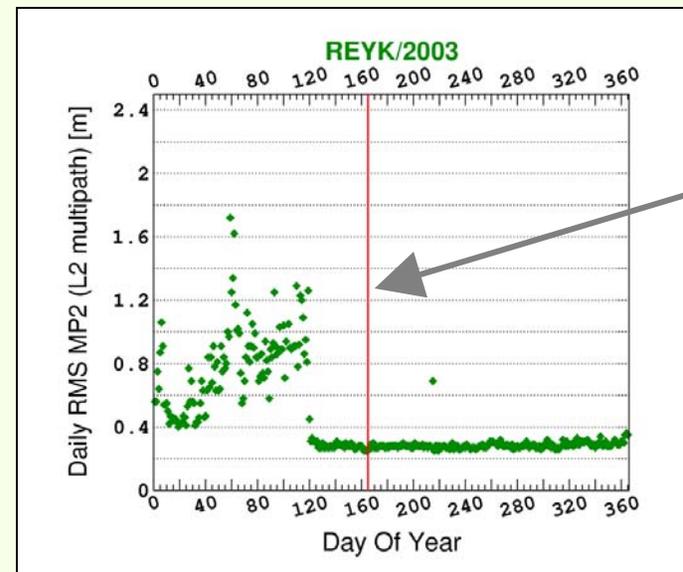
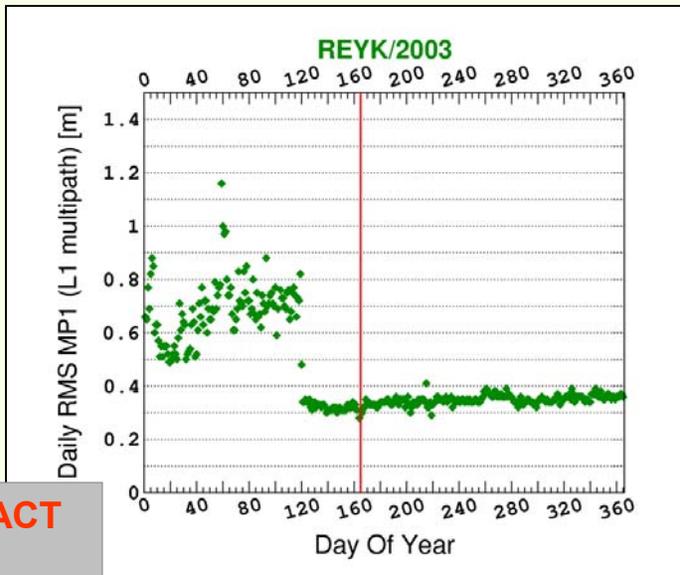
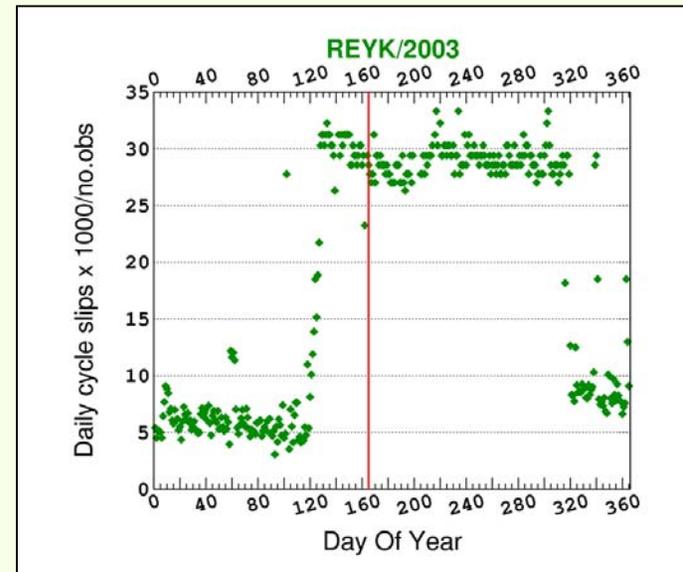
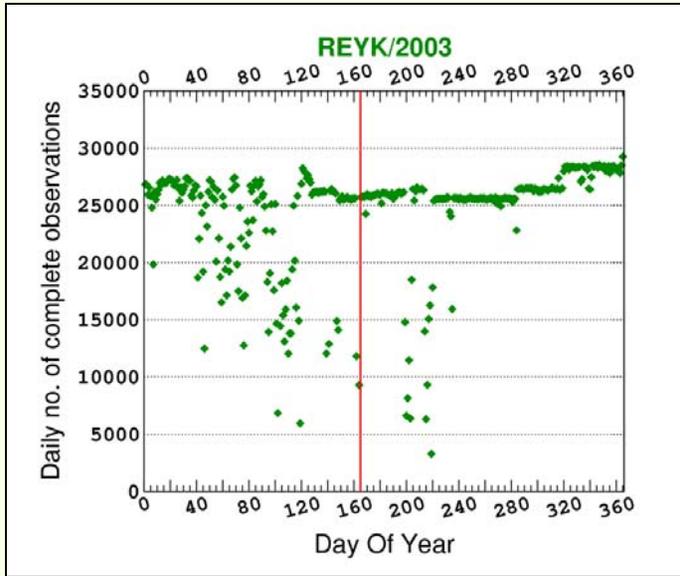
- 45-day averages of recent data
- overview in yearly plot

45-day average of recent data



Similar
info
available at
IGS CB

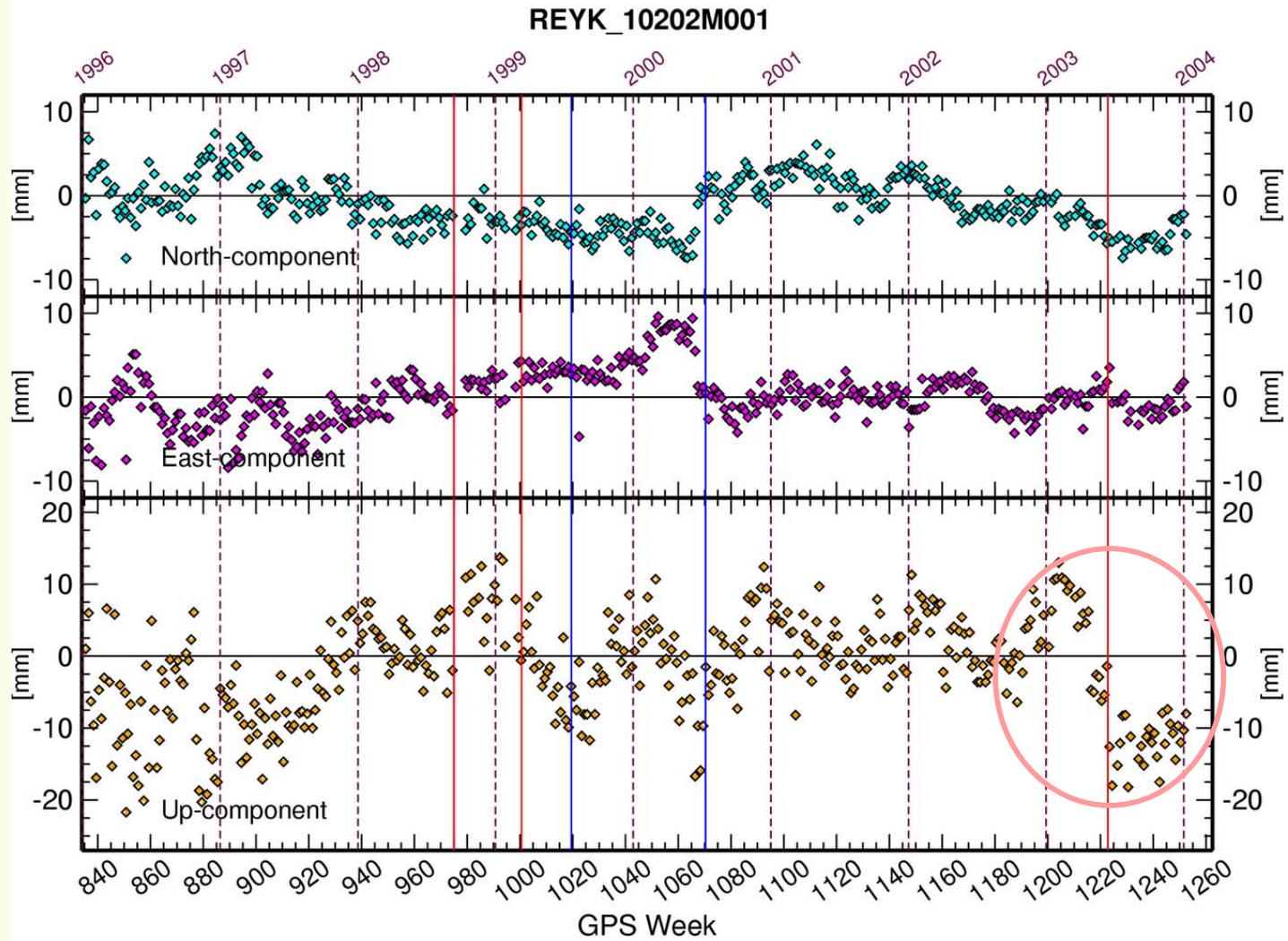
Yearly overview



**Antenna
change
(site log)**

**AOA SNR-8000 ACT
AOAD/M_T**

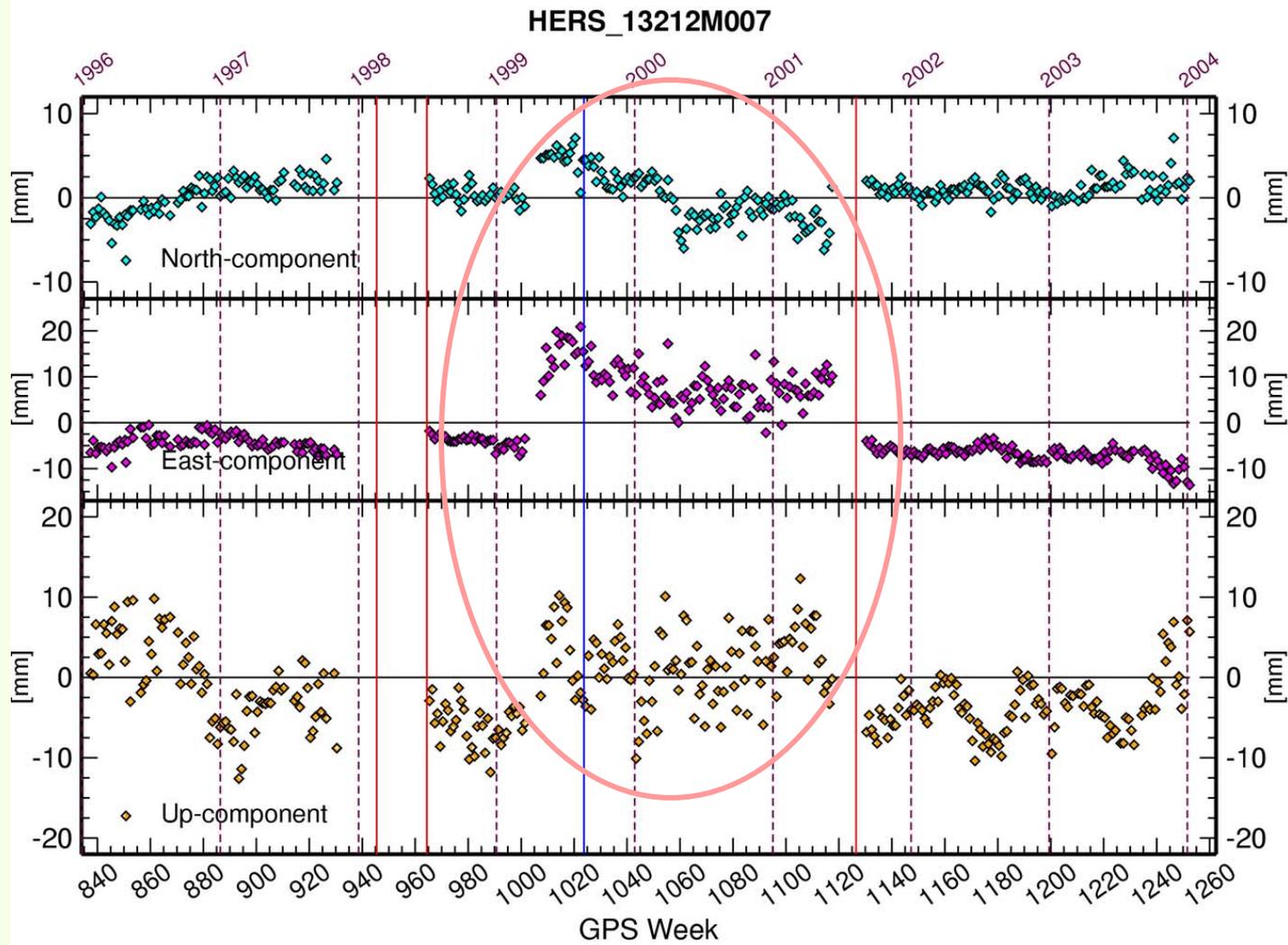
EXAMPLE - REYK



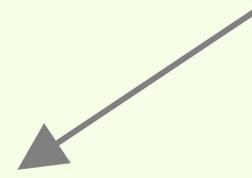
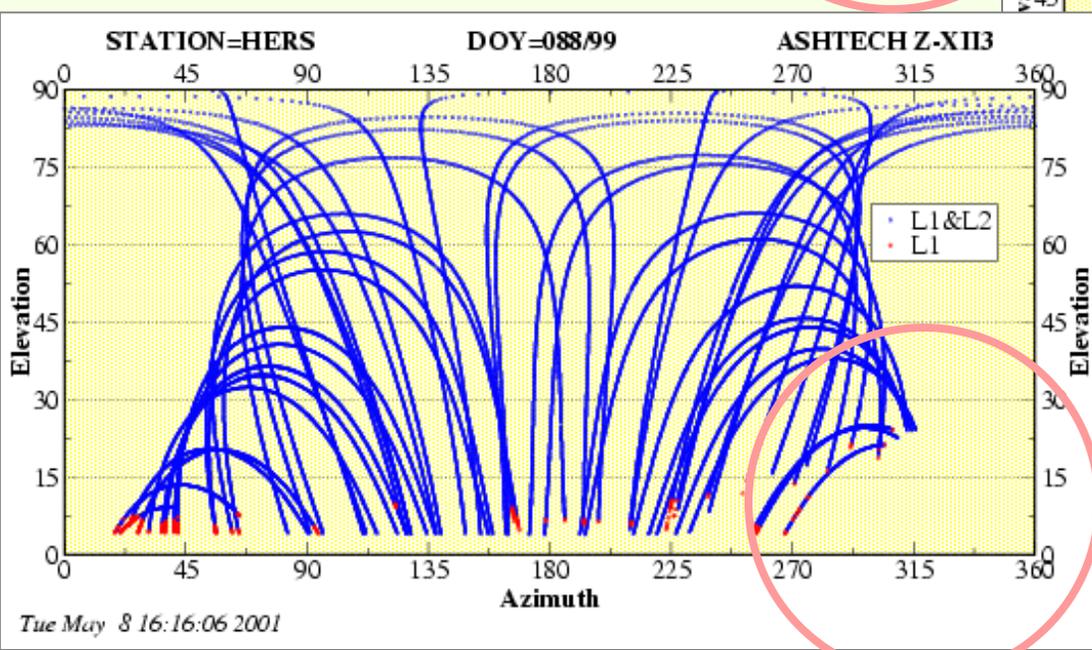
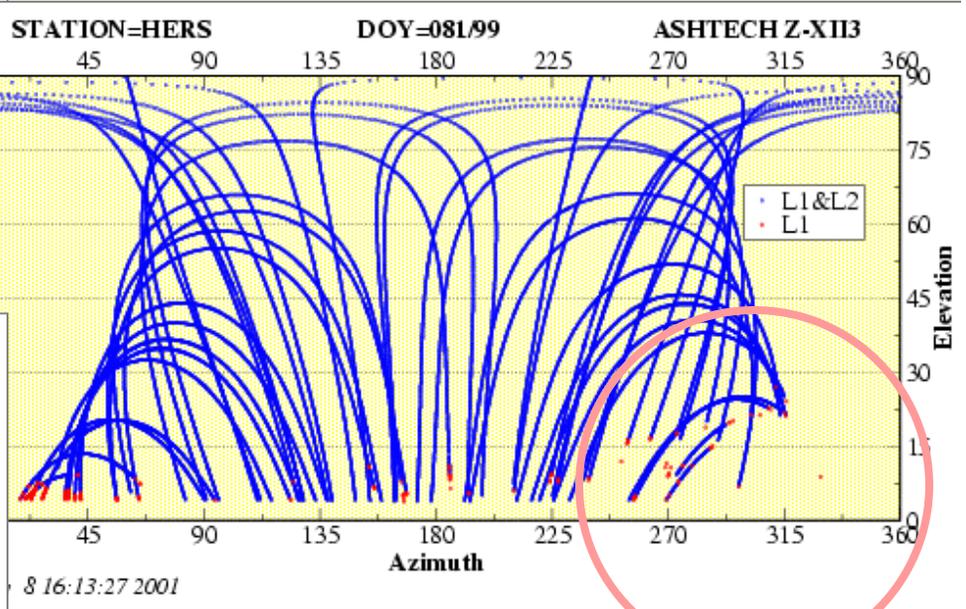
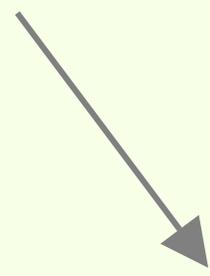
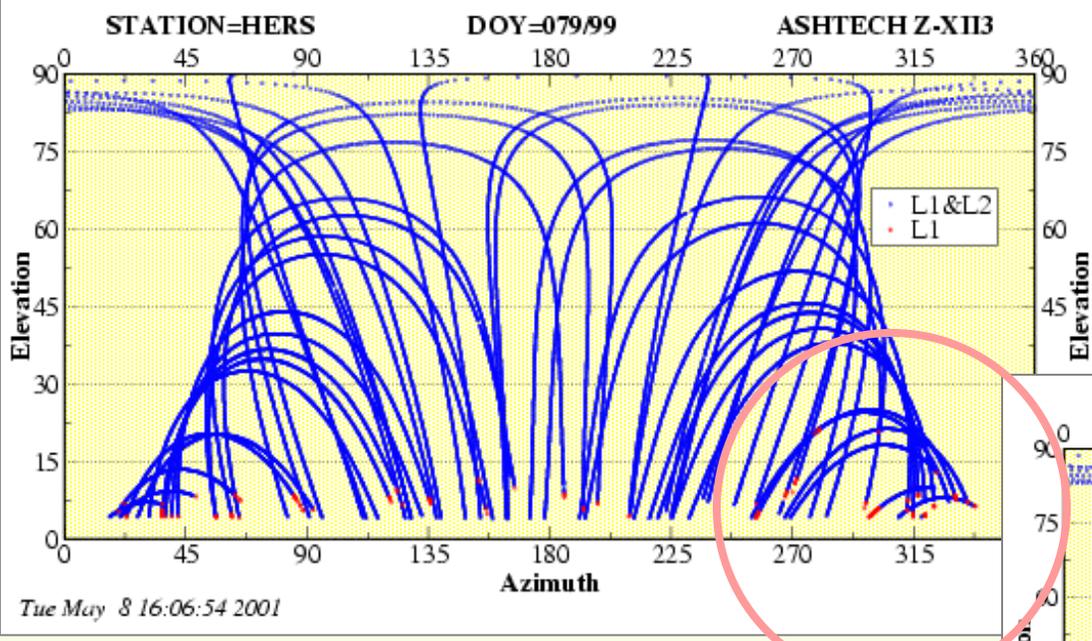
Use monitoring info to evaluate ‘irregularities’ in time series

Time series computed using CATREF (Altamimi)

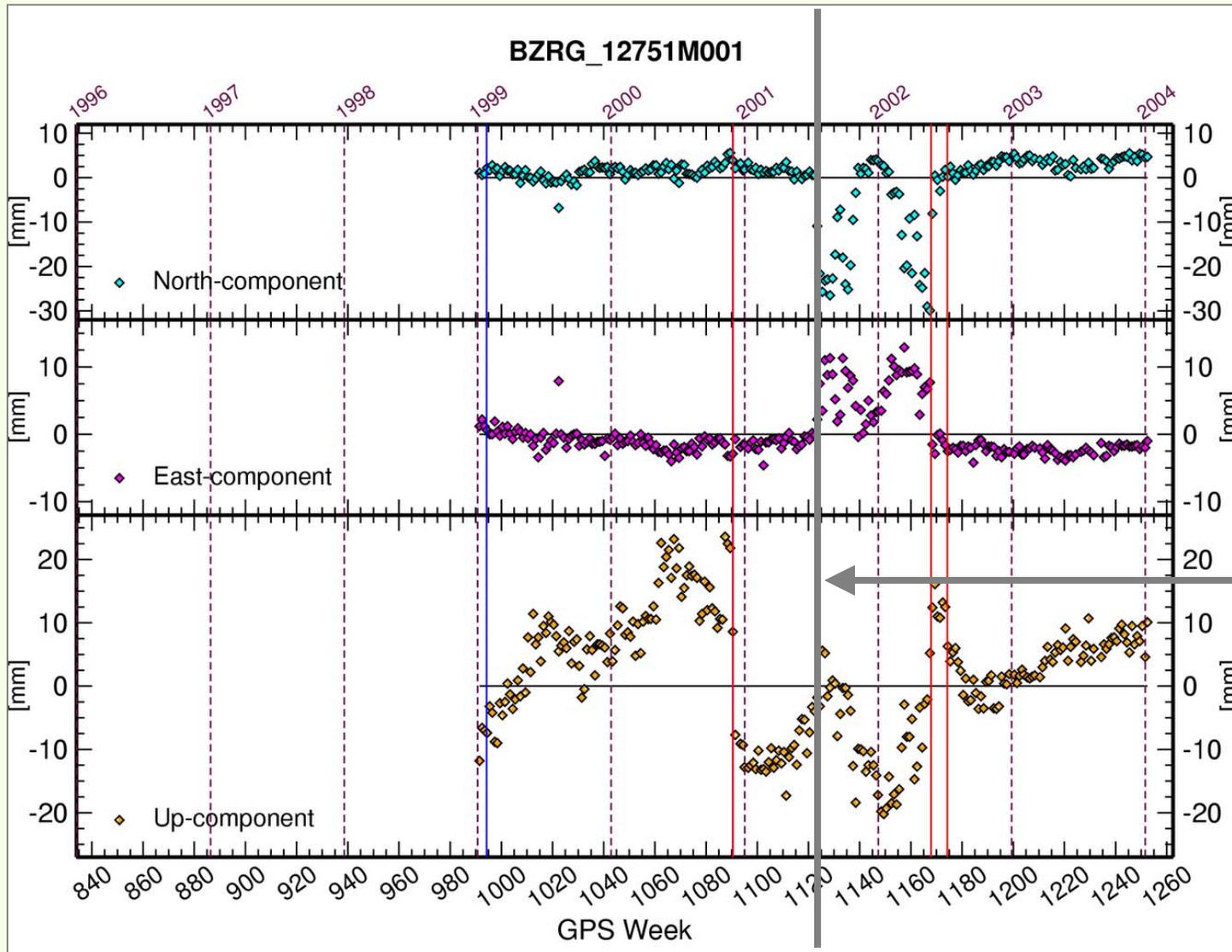
CASE 1 : HERS



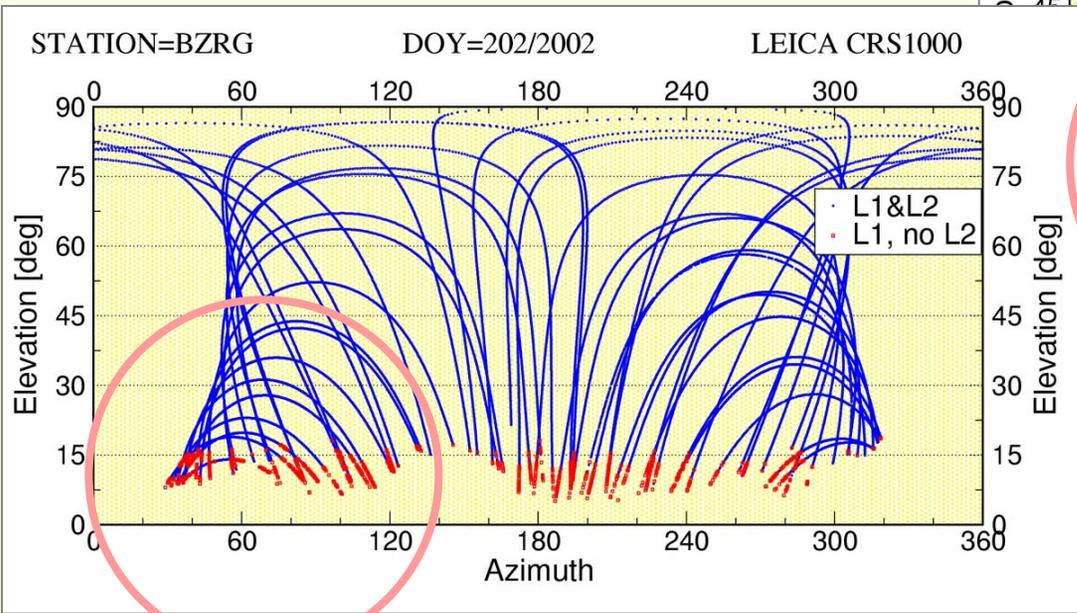
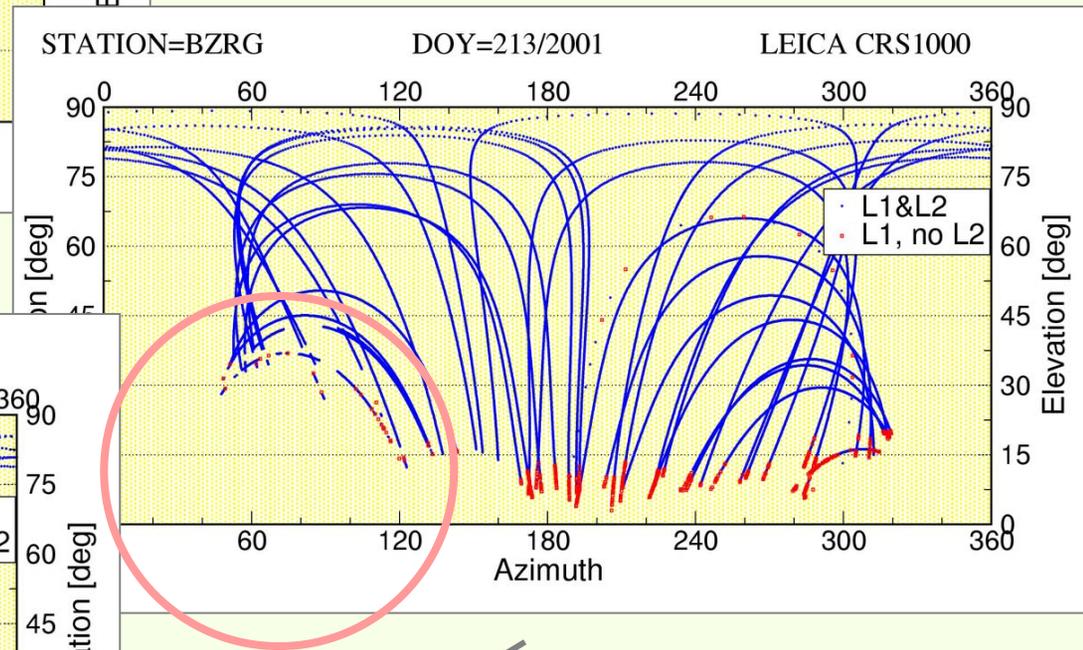
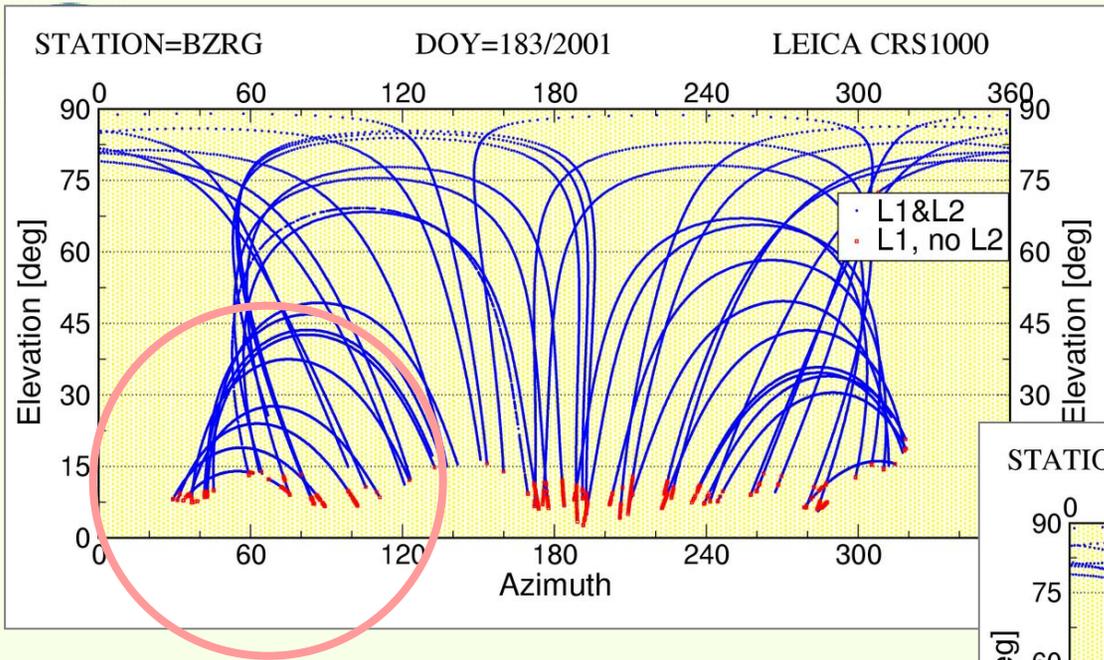
**Degradation
of ambiguity
resolution**



CASE 2: BZRG

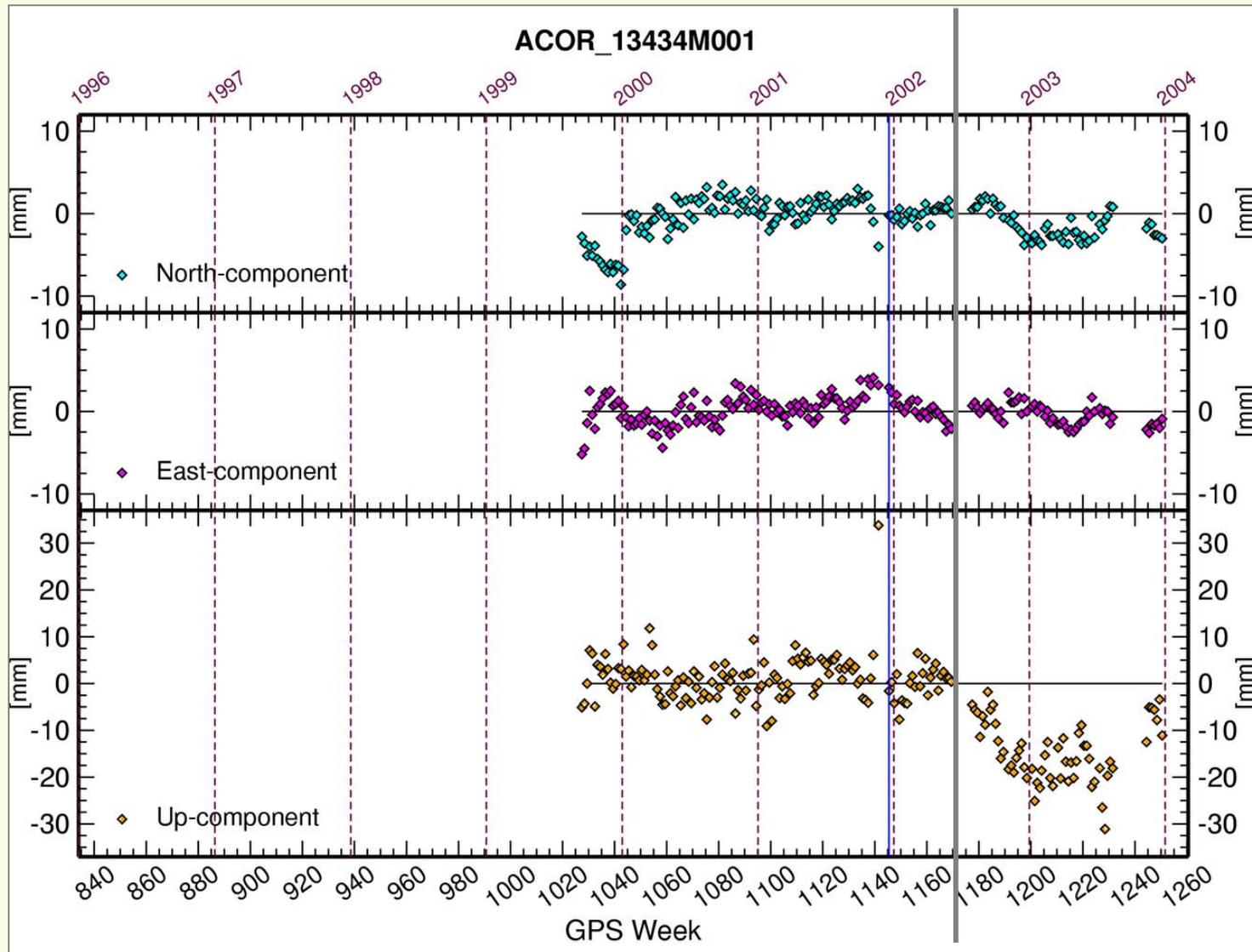


**Jul 17, 2001,
(1123/2)
earthquake very
near to BZRG**



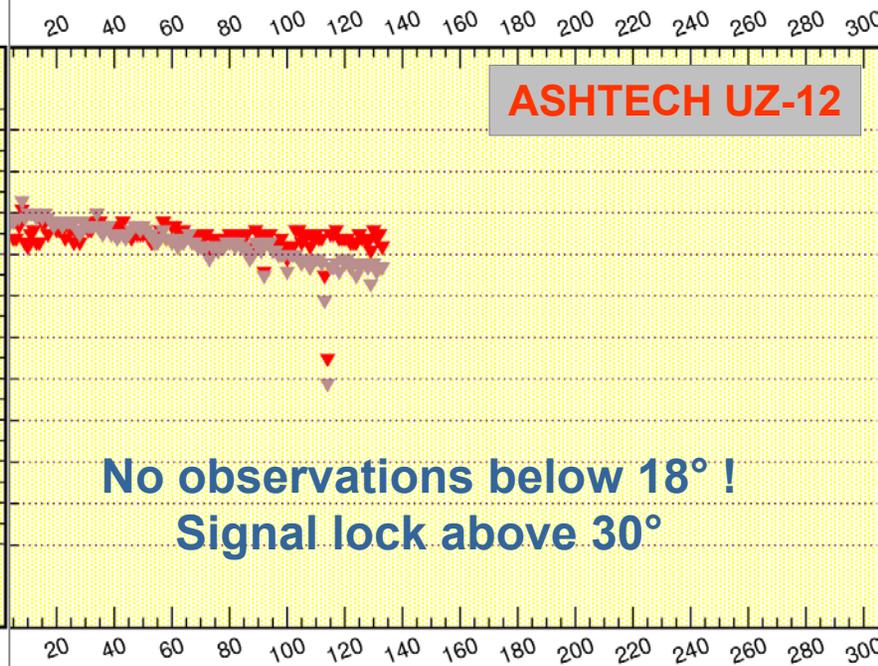
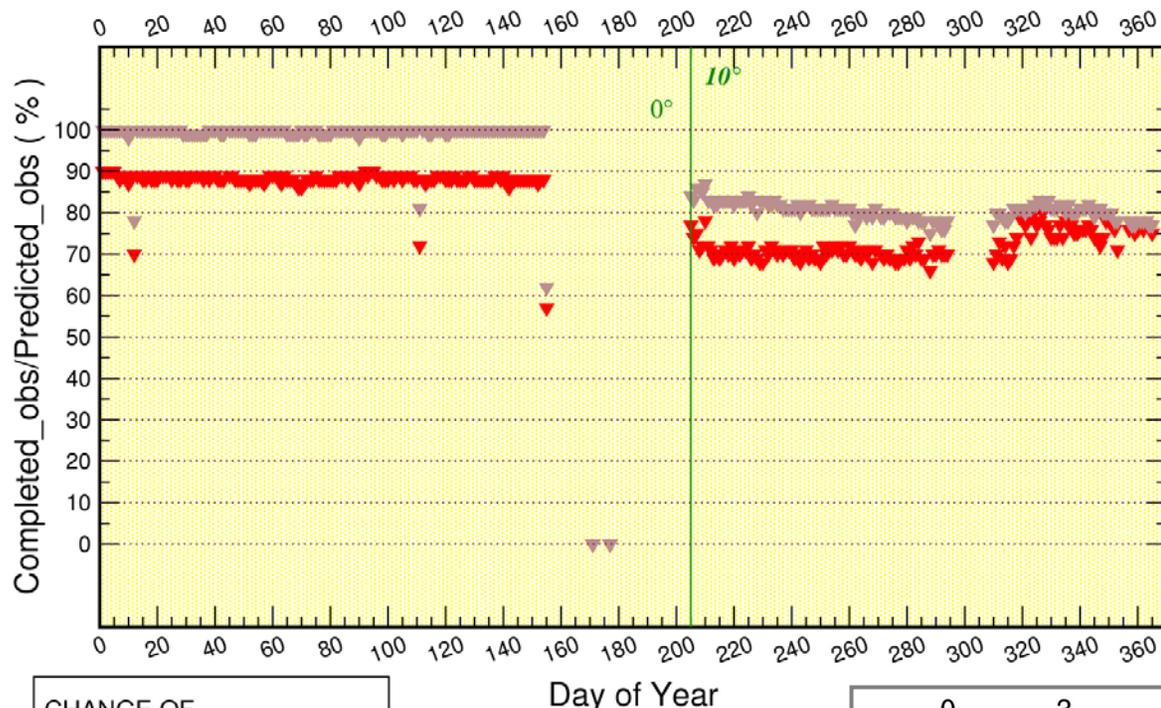
Start DOY 199, 2001
End DOY 149, 2002

CASE 3: ACOR



ACOR/2002

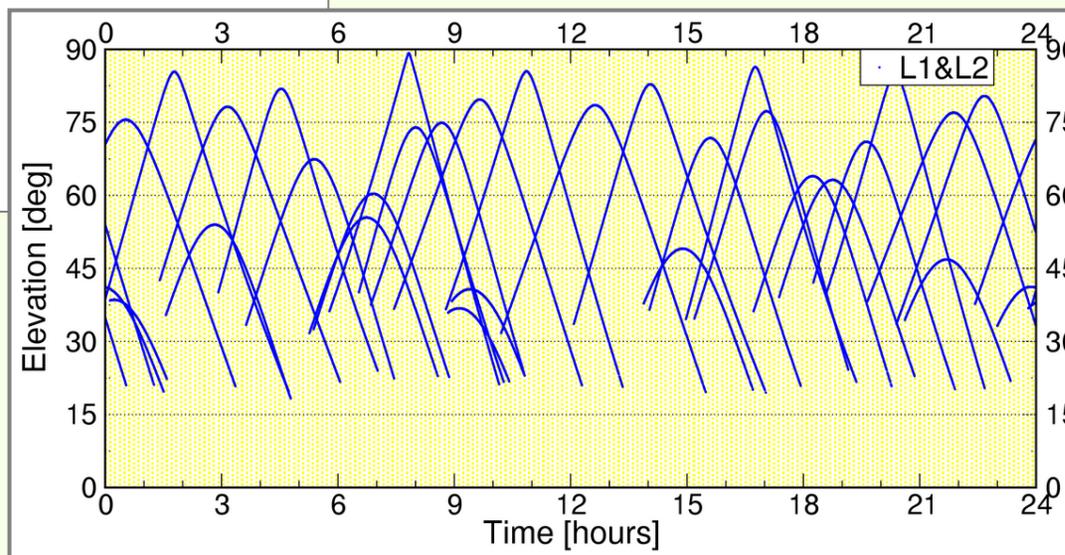
ACOR/2003



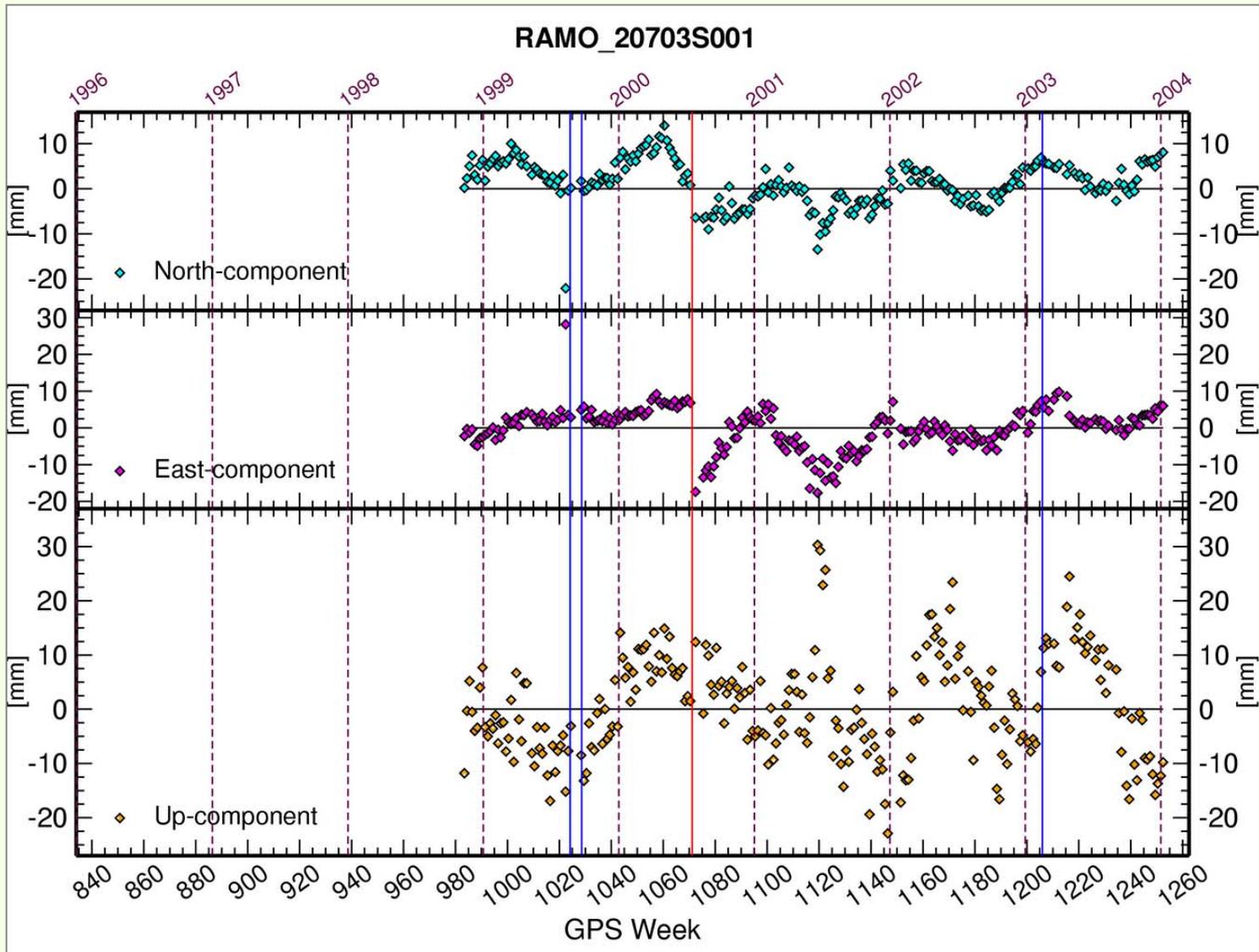
CHANGE OF

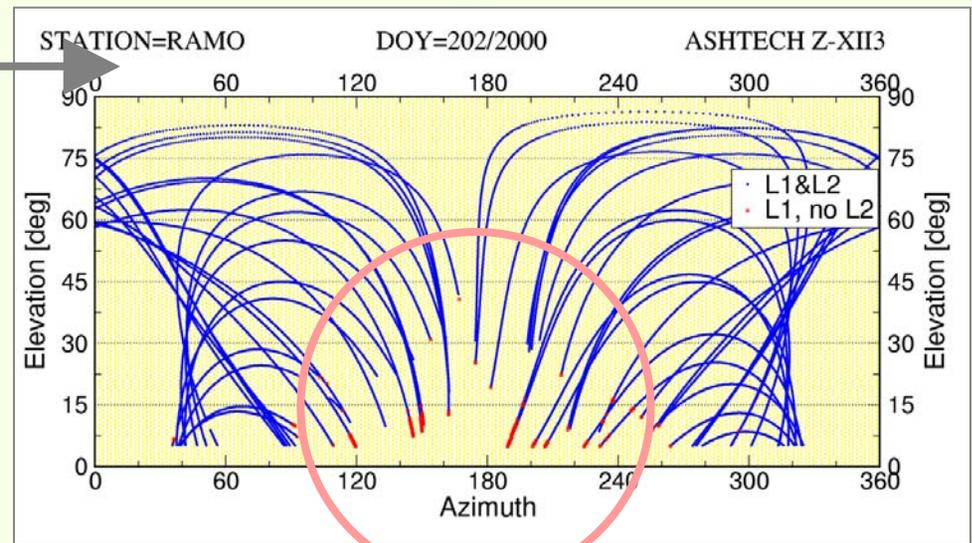
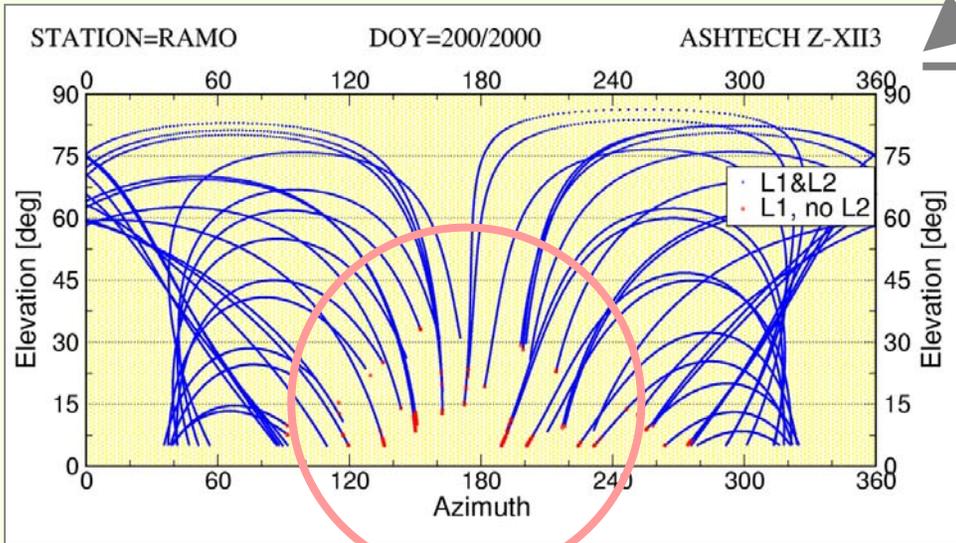
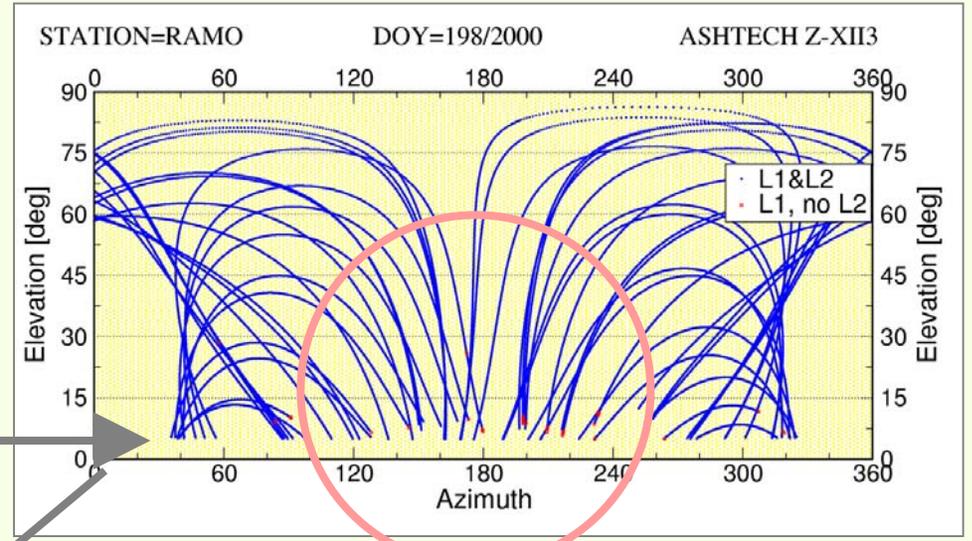
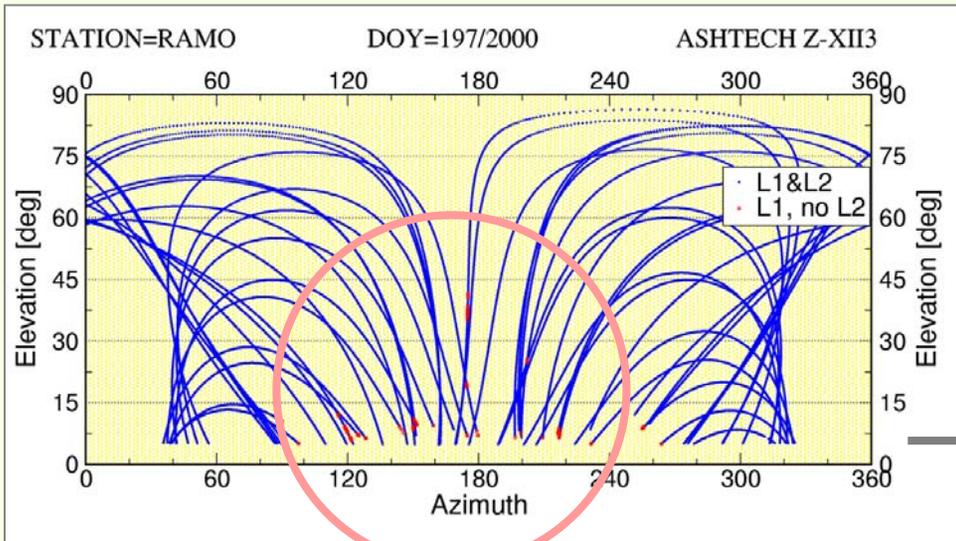
- current cut-off
- receiver or firmware
- antenna or dome
- antenna and receiver

- ▼ with the current cut-off
- ▼ with a cut-off at 15°
- current number of channels = 12*



CASE 4: RAMO (1)





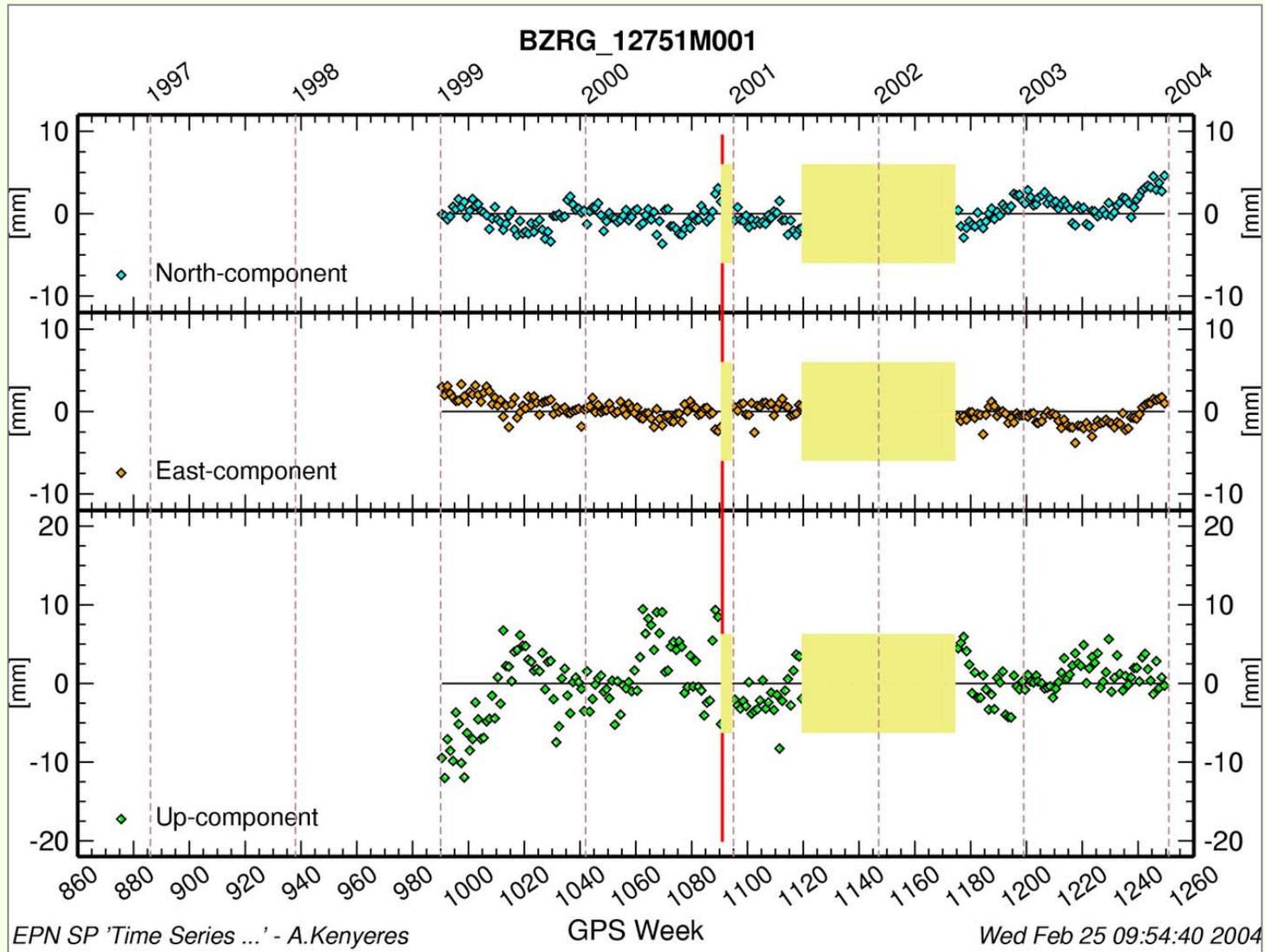
Time Series Special Project

Uses information from station monitoring and from the time series to generate so-called ‘Improved time series’

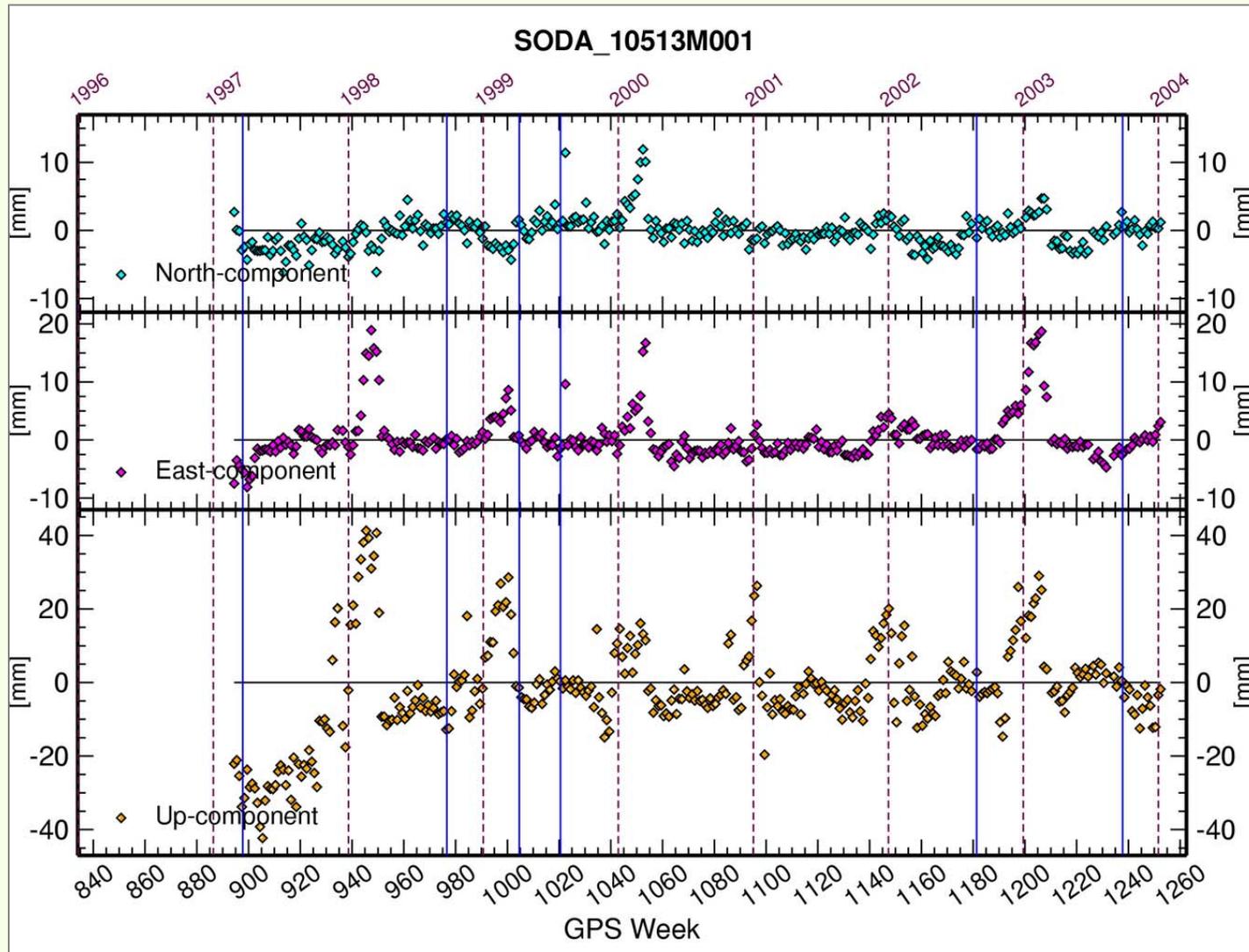
- Identification of periods that station coordinates are unreliable
 - Do not use this station for densification purposes
- Determination of coordinate discontinuities
 - Apply a correction to the ITRF2000 coordinate

Information is available at EPN CB web site

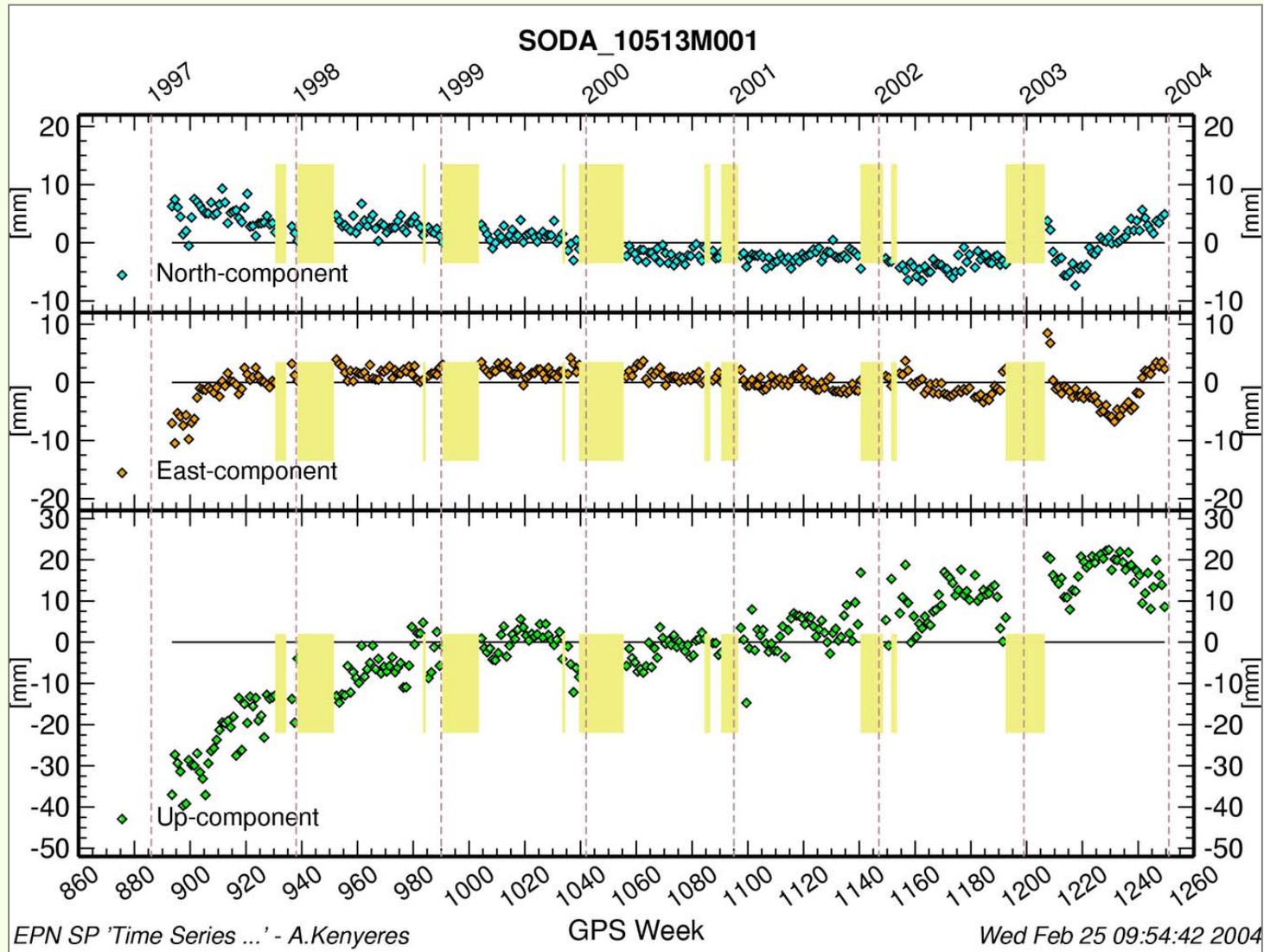
CORRECTED - BZRG



EXAMPLE – SODA



CORRECTED – SODA



SUMMARY

- Very simple tools to monitor tracking of a station
- Especially long-term behaviour of different parameters is interesting
- Demonstrated a clear correlation between tracking changes and irregularities in computed coordinates
- Special Project 'Time Series monitoring' identifies for each station time periods with unreliable coordinates and estimates the coordinates jumps due to equipment changes

Station managers should take the time to check the performance of their station using the information the CB makes available

some tracking problems are detected with too much delay!